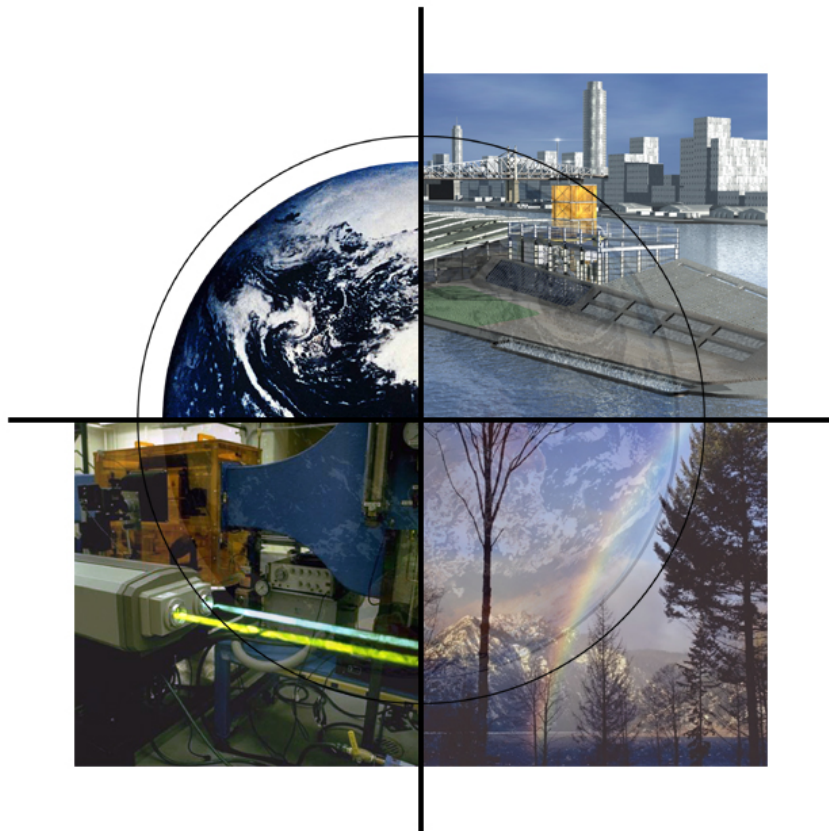


# Tangible Benefits of New Clean Coal Technologies



*Presented by  
Mike Eastman, Manager  
Clean Coal Technology  
Demonstrations*

*at*

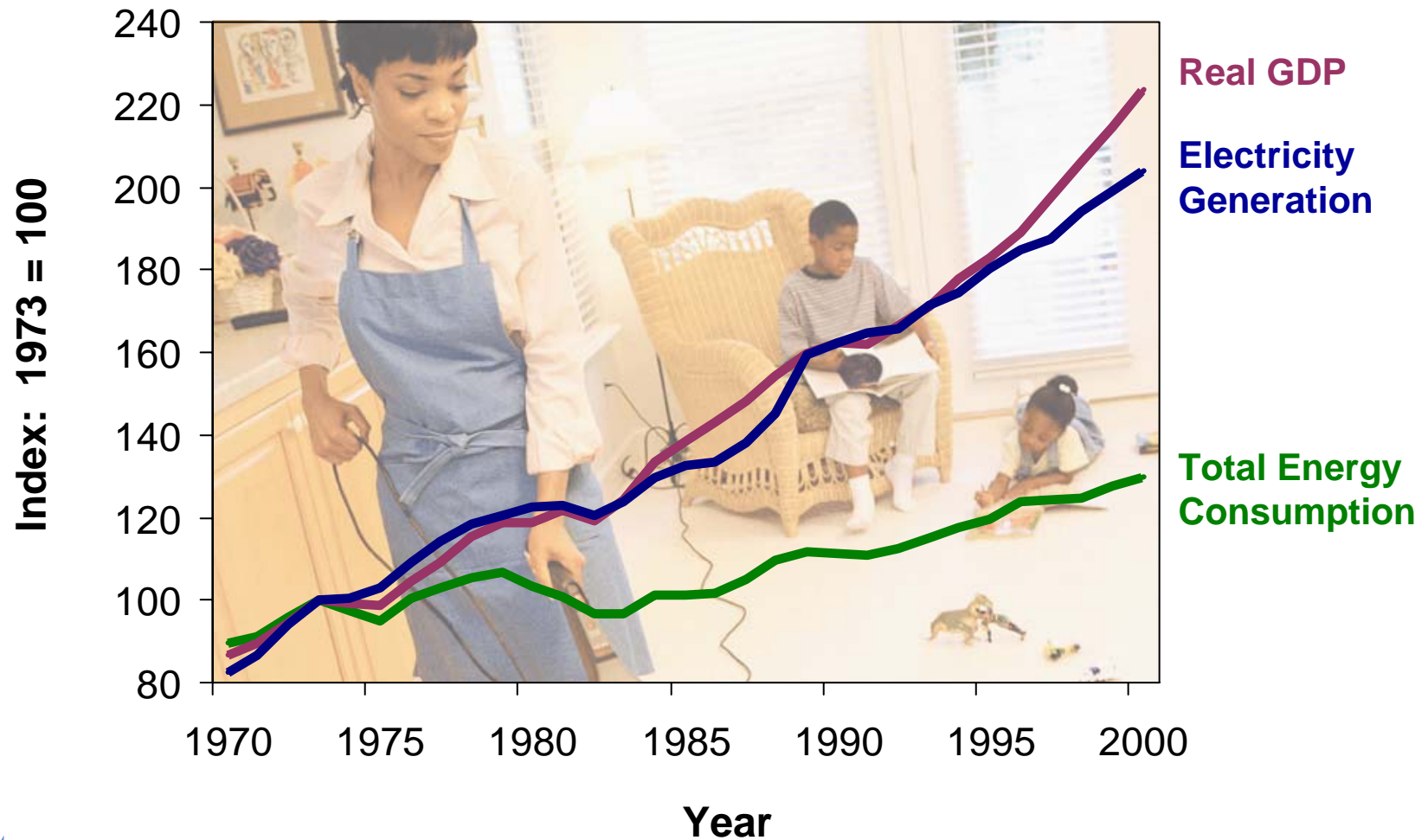
*POWER-GEN International 2003  
Las Vegas, NV*

*December 11, 2003*

National Energy Technology Laboratory



# Economic Growth Linked to Electricity



# Coal Power Program Roadmap

## Addresses Near- and Long-range Needs

- **Short-term: existing fleet**
  - Cost-effective environmental control technologies to comply with current and emerging regulations
- **Long-term: future energy plants**
  - Near-zero emissions power and clean fuels plants with CO<sub>2</sub> management capability

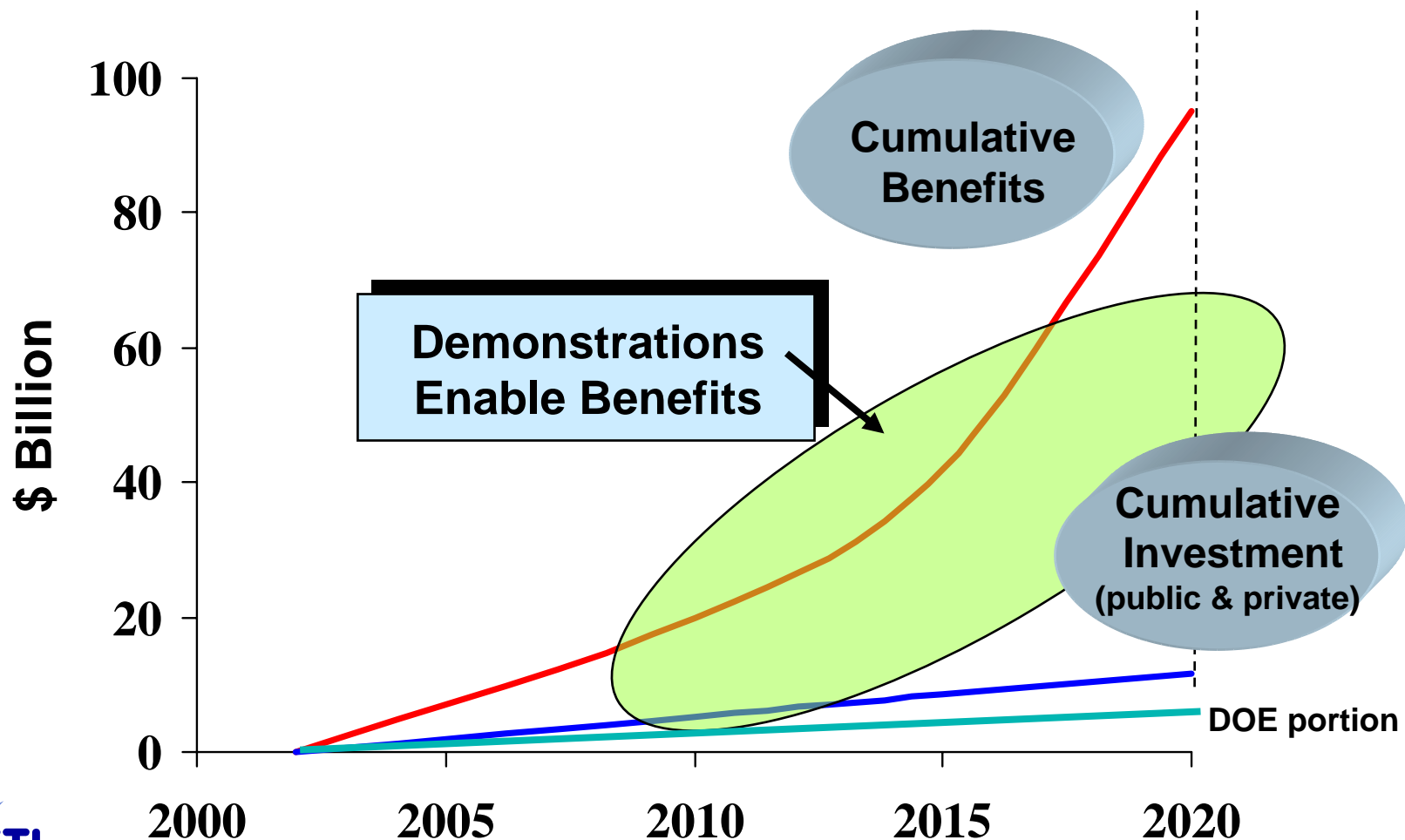


Can be found on CURC website

**[www.coal.org](http://www.coal.org)**

# Demonstration Initiatives are Key Pathway to Benefits

## *Coal Program - Benefits/Investment*



# Coal Power Program (RD&D) – Economic Benefits

Savings Categories	Cumulative Benefits (\$ billions, thru 2020)
Fuel Cost	10
Capital Cost (New Plants)	12
Control Technology Cost (Existing Plants)	32
Avoided Environmental Costs	10
Technology Export	36
<b>Total Benefit</b>	<b>100</b>

## Other Benefits

- Increased jobs from technology export – estimate 75,000 new jobs in 2010 increasing to 200,000 in 2020
- Additional \$500 billion to \$1 trillion savings through 2050 if loss of coal option results in 1-2 ¢/kWh increase in cost of electricity

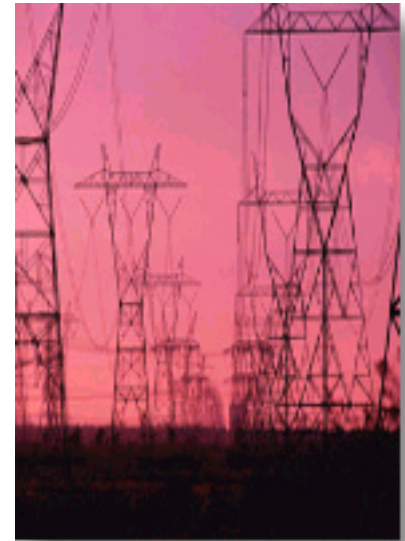


# Approach to Estimating Benefits

## ...by Project

## ...by Technology

- Forecast market penetration
- Quantify differences between performance of conventional technology and anticipated performance of advanced technology being demonstrated
  - Pollutant emissions, tons per year
  - Fuel cost, constant dollars
  - Annual power generation, kWh
  - Capital and operating cost, constant dollars





# Great River Energy Project

- A 546 MW<sub>e</sub> demonstration of Lignite Fuel Enhancement System
- Installed on a PC Boiler with a tangential firing configuration using North Dakota lignite at Great River Energy's Coal Creek Station Unit 1, Underwood, ND
- Total project funding: \$22,000,000  
DOE share: \$11,000,000 (50%)



Coal Creek Station

# Anticipated Performance at Coal Creek Station

- Overall thermal performance improved by 5%
- Cost of generation reduced by \$0.70/MWh (\$3 Million per year)
- Less duct erosion and maintenance cost
- Reduction in fan and mill power
- Increased reliability: fewer outages
- 7% reduction in NO<sub>x</sub>, CO<sub>2</sub>, Hg, and particulate emissions
- 25% reduction in SO<sub>2</sub> emissions





# Benefits of Technology for Coal Creek

Pollutant	Annual Emission Reduction
NO <sub>x</sub>	376 tons
SO <sub>2</sub>	3,580 tons
CO <sub>2</sub>	386,860 tons
Particulate Matter	510 tons
Mercury	16.2 pounds

**Total Emissions at Coal Creek Plant are estimated to decrease by 7% to 25% due to installation of Lignite Fuel Enhancement System**



# Estimated Reductions in National Pollution Emissions from Commercialization

	Emission Reduction <sup>1</sup> , tons/year	Current Emissions from all Coal-fired Boilers in United States <sup>2</sup> , tons/year
NO <sub>x</sub>	6,890	4,611,940
SO <sub>2</sub>	18,360	10,773,220
CO <sub>2</sub>	7,084,810	2,133,109,930
Particulate Matter	9,340	522,360
Mercury	0.15	48.6



<sup>1</sup> Basis: 10.0 GWe market penetration

<sup>2</sup> Source: NETL Coal Power Data Base

# TOXECON Project

- 270 MW<sub>e</sub> demonstration of TOXECON Mercury and Multi-Pollutant Control Technology
- Installed on combined flue gas stream of units 7, 8, and 9 using low-sulfur, PRB sub bituminous coal at Wisconsin Electric Power Company's Presque Isle Power Plant in Marquette, Michigan
- Total project funding: \$49,536,600  
DOE share: \$24,768,300 (50%)



Presque Isle Power Plant

# Benefits of TOXECON Technology for Presque Isle Power Plant

Pollutant	Annual Emission Reduction
NO <sub>x</sub>	1,470 tons
SO <sub>2</sub>	4,020 tons
Particulate Matter	32 tons
Mercury	80 pounds

**Multi-pollutant strategy reduces release of pollutants at Presque Isle Power Plant to very low levels**



# Assumed Commercial Market for TOXECON Technology

- 749 units generating 223 GW<sub>e</sub> in existing market
- Projected to be 108 new coal-fired units generating 54 GW<sub>e</sub> by 2025
- 52 units generating 17 GW<sub>e</sub> in Canadian market
- National benefit estimates are based on capturing 97 GW<sub>e</sub> North American market



# Estimated Reductions in National Pollution Emissions from Commercialization

	Emission Reduction <sup>1</sup> , tons/year	Current Emissions from all Coal-fired Boilers in United States <sup>2</sup> , tons/year
NO <sub>x</sub>	409,350	4,611,940
SO <sub>2</sub>	2,759,200	10,773,220
Particulate Matter	37,300	522,360
Mercury	14.0	48.6

<sup>1</sup> Basis: 97 GWe market penetration.

<sup>2</sup> Source: NETL Coal Power Data Base.





# Tentative Priority Technologies

## *Future CCPI Rounds*

- **Emission control**

- Mercury
- NO<sub>x</sub>

- **Advanced Power Technologies**

- Improved efficiency/lower capital cost
- Sequestration friendly

- **Sequestration**

**Round 2**

**Round 3**

**Round 4**

**Technologies  
for Clear  
Skies  
Compliance**

**Technologies  
For Zero-  
Carbon  
Emission  
Plants**

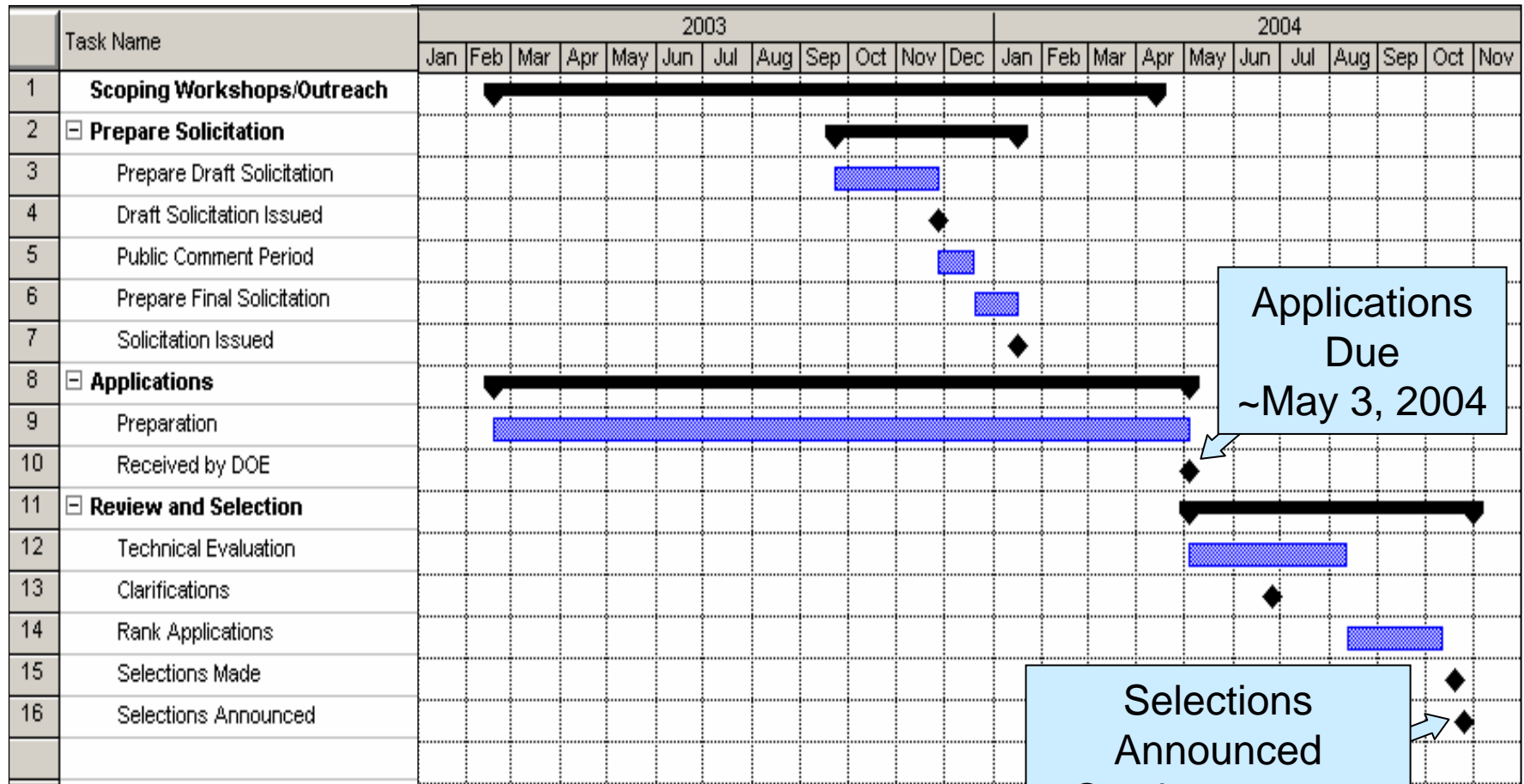
**Program  
Goals**



# CCPI Round 2 Schedule

## *Path to Selection*

*(Dates Approximate)*



# Closing Comments

- **Coal must play a key role to secure a healthy economy**
  - Is recognized in Presidential-level initiatives; Clear Skies, Climate Change, FutureGen, Hydrogen, Sequestration
  - Coal can play an important role in a potential future carbon-constrained world
- **Regulatory uncertainty improving (e.g. NSR)**
- **Coal RD&D Roadmap charts challenging but doable path forward**
  - Best ideas needed
  - Sustain Federal and private sector investments



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[www.netl.doe.gov](http://www.netl.doe.gov)

# Visit Our OCES Website

[www.netl.doe.gov/coalpower/](http://www.netl.doe.gov/coalpower/)


**NATIONAL ENERGY TECHNOLOGY LABORATORY**  
 United States Department of Energy

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February 09, 2003

**TOP NEWS STORIES**



**DOE Names Winners of Clean Coal Competition**  
**\$1.3 Billion of Projects Aimed at Clear Skies, Climate Change & Coal Waste Cleanup**  
 The Department of Energy has named the first winners in President Bush's [Clean Coal Power Initiative](#). The eight projects are valued at more than \$1.3 billion and include new technologies to reduce air pollutants, boost power plant efficiencies, and extract energy from coal waste piles. [Read More!](#)

**Experimental Fiber Optic Cables To Warn of Potential Pipeline Damage Tests Begin of an "Early Warning" System To Prevent Damage to Natural Gas Pipelines**  
 Technicians in a joint DOE-industry project have deployed fiber optic cables over a mile of an active gas pipeline in the first test of a new system to detect encroaching construction activity. [Read More!](#)



**Gas Upgrading R&D "Success Story"**  
 A new gas upgrading technology funded by DOE and the Gas Technology Institute moves to market. [Link To GTI Announcement](#)

**NEW! DOE AWARDS NEW CONTRACTS TO IMPROVE POWER PLANTS BY:**

**Recycling Coal Combustion Ash**  
 A cooperative agreement with Universal Aggregates, LLC calls for a manufacturing plant at the Birchwood Power Facility in King George, Virginia, to turn coal ash into aggregate. [Read More!](#)

**Integrating Lower Cost NOx Controls**  
 A unique combination of high-tech combustion modifications and sophisticated control systems will be tested on a Kansas coal plant to show how new technology can reduce air emissions and save money. [Read More!](#)

**Visit the Homeland Security Energy Infrastructure Website!**

**SPECIAL ANNOUNCEMENTS**

- [Powder River Coal Can Be Rich Source of Natural Gas](#) [PDF]
- [Abraham Announces Plans to Expand Sequestration Program](#)
  - [Regional Carbon Sequestration Partnerships Solicitation](#)

**BUSINESS SECTORS**

- Strategic Center for Natural Gas
- Coal and Env. Systems
- Climate Change Policy Support
- National Petroleum Technology Office
- Env. Technologies & Business Excellence
- Homeland Security Energy Infrastructure


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**Office of Coal & Environmental Systems**

Playing a central planning and coordination role in ensuring that coal is sustained as an abundant, affordable, and acceptable resource for satisfying our country's need for energy, now and well into the future.

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Through this website, we hope to answer your questions about using coal as a reliable, stable, and sustainable source for electric power. We will share with you the technologies in place now to make this a reality, and the planning, funding, and development efforts to make tomorrow's technologies a reality, today.

[Tracking New Coal-Fired Power Plants](#) (PDF-445KB)

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Advanced Research  
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 Clean Coal Power Initiative (CCPI)  
 Combustion Technologies  
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 Gasification Technologies  
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